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ABSTRACT

Elementary science instruction in the Tenafly Public Schools became virtually nonexistent in the early 1980's and based on this realization, members of that school system embarked upon a 3-year curriculum renewal cycle. The process followed in the curriculum development plan is somewhat unique and may serve as a model for other school districts to follow. In phase I, a curriculum study group was formed with teacher representatives from all grade levels and areas of administration. Current practices were examined and literataure was reviewed and analyzed for local applicability. At the end of the year, recommendations for pilot projects were made. In phase II, the pilot projects were installed and subjected to an intensive evaluation involving input from students, teachers, administrators, and parents. At the end of the pilot year, recommendations for final implementation were made. Phase III involved the actual implementation of the new curriculum. Another intense evaluation was conducted and final recommendations were made. The viability of the newly-installed curriculum is considered to be 5 years, at which time the renewal cycle is slated to begin once again. The study group will remain intact to deal with problems and to infuse current ideas into the ongoing program. (Author/JN)

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TENAFLY PUBLIC SCHOOLS
TENAFLY, NEW JERSEY

A SCIENCE CURRICULUM RENEWAL CYCLE

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TENAFLY PUBLIC SCHOOLS
TENAFLY, NEW JERSEY

COMMUNITY INFORMATION

Tenafly is a Hudson River town located in suburban Bergen County, New Jersey, five miles northwest of New York City. The town is approximately 4.4 square miles in area and consists mainly of privately owned, one family homes. Tenafly is attractive, quiet and residential with carefully protected wooded areas and well maintained recreational facilities.

Of a population of approximately 13,450, many commute to New York City; others are employed locally. The socio-economic level is generally well above the national average, and the community has consistently demonstrated an active interest in and willingness to support a high quality of education. Residents, many of whom are distinguished in the arts, sciences, business and medical professions, actively participate in civic activities and voluntarily share their expertise with students in the classroom.

The borough's proximity to New York City puts its theaters, dance, museums, concert, opera, exhibits, movies, bontanical gardens, and sports events within easy reach. In addition, there are community chorus, orchestra, and drama groups.

The public schools are organized into four elementary (K-5), one middle (6-8), and high (9-12) school buildings. On September 28, 1984, the enrollment in kindergarten through grade 12 was 2,302 pupils.

The professional staff numbers about 196 and includes classroom, music, art, physical education, special education and supplemental teachers, librarians, nurses and guidance counselors. One hundred seventy-two or 85 percent have master's degrees. Five more have doctorates.

Central office staff includes: Superintendent of Schools Harry Jaroslaw, Assistant Superintendent Walter A. Wollam, Assistant Superintendent/Board Secretary Daniel P. Knueppel, and Public Information Officer Mary C. Salpukas. The Administrative staff also includes six building principals and two vice-principals.

A nine-member elected board of education determines the policies for the district. The community is actively involved in the schools. Members serve as representatives on board of education appointed committees and work in education oriented organizations.

Home School Associations operate actively in all of the schools, providing volunteer services, education programs for parents, and enrichment opportunities for children.

It is the goal of the Tenafly Schools to provide individualized programs that help each child realize his or her full potential. Options are made available, wherever possible, for students with different learning styles and abilities.

TENAFLY PUBLIC SCHOOLS
TENAFLY, NEW JERSEY

ABSTRACT

Elementary science instruction in the Tenafly Public Schools had become virtually nonexistent in the early 1980's and based on this realization, members of that school system embarked upon a three-year curriculum renewal cycle initiated by the Superintendent of Schools. The process followed in the curriculum development plan is somewhat unique and may serve as a model for other school districts to follow. The cycle represents a systematic assessment procedure and establishes three phases of study, the first of which is a year-long period of research and development. In Phase I, a curriculum study group was formed with teacher representatives from all grade levels and areas of administration. Current practices were examined and literature in the field was reviewed and analyzed for local applicability. Exemplary programs in other schools were surveyed and materials available in the marketplace were scrutinized. At the conclusion of this first year of study, recommendations for pilot projects were made.

In Phase II of the curriculum renewal cycle, the pilot projects were installed and subjected to an intensive evaluation involving input from pupils, teachers, administrators and members of the parent body. At the end of the pilot year, recommendations for final implementation were made.

Phase III of the cycle involves the actual implementation of the new curriculum. Another intense evaluation was conducted and final recommendations were made. The viability of the newly-installed curriculum is considered to be five years at which time the renewal cycle is slated to begin once again.

The Superintendent and the Board of Education were unusually supportive of the recommendations of the Study Group and human and material resources were committed to the improvement of the elementary science program. The resultant curriculum emphasizes a "hands-on" approach to science instruction and encourages teachers and children to "take risks" as they investigate materials and phenomena in their physical and natural environments.

In the years following the Implementation Phase of the cycle, the Study Group remains intact to deal with problems as they arise and to infuse current ideas into the ongoing program.

PROGRAM DESCRIPTION

I. HISTORICAL BACKGROUND

The Tenafly Public Schools, long known for curriculum innovation and receptivity to new ideas, was quick to join the energetic, almost frenetic, national effort to develop elementary school science programs which occurred in the 1960's. Tenafly Elementary Schools had become a trial center for one of the more ambitious national curriculum projects in science, the SCIS (Science Curriculum Improvement Study) program. Supported by the National Science Foundation at the University of California and later published, commercially, by Rand McNally, this program remains one of the most highly respected elementary school science laboratory approaches available.

Professional development was a priority in the mid 1960's and a science consultant was retained for this purpose for a few years. By 1980, the professional support to teachers for science instruction had become virtually nonexistent and this, combined with a lack of maintenance of science materials and kits, as well as the influx of new teachers who had no experience in the program, resulted in a rather widespread absence of science instruction in the elementary schools. Science teaching had become overshadowed by what was viewed as the more pressing demands of the reading and math programs, and this along with the time required to acquire and set up material for science instruction also contributed to the disenchantment in this area of instruction.

In September 1982, the Superintendent of the Tenafly Public Schools outlined a curriculum renewal cycle, used in other subject areas, which would be applied to alleviate the problem noted in science instruction. Coincidentally, at this time, a new principal was hired for one of the elementary schools and a great priority was placed upon seeking an educator with a strong background in elementary school science. The curriculum renewal cycle was set in motion and the new work in science was underway.

II. CURRICULUM RENEWAL

The curriculum renewal cycle operative in the Tenafly Public Schools establishes a systematic assessment of instructional programs and practices and results in recommendations for change as needed. The overriding philosophy of this study assumes that curriculum is a "living thing"; its nature is inert, but the instructional practices and involvement are alive. Curriculum is reflective of its social contexts and if conditions in that environment change, a periodic examination of curriculum priorities and procedures is necessary.

The goals of such a curriculum review may be summarized as follows:

1. To establish a systematic program of curriculum review and assessment.

2. To analyze and interpret current programs and practices in a given curriculum area.

3. To make assessments and judgements based upon study and review of its practices.

4. To suggest program modifications consistent with current information in the particular field.

5. To chart a path for future development in the particular curriculum area.

The science program which emerged was developed through the curriculum renewal cycle. Phase I - Research and Development was carried out during the 1982-83 school year. In this first year of curriculum study, a committee composed of teachers and administrators was formed to examine current practices in elementary school science instruction. A working philosophy and goals for science education was established. A review of literature in the field was conducted including an examination of the classical statements as well as more recent research and articles. Current programs and practices were assessed using questionnaires distributed to teachers, parents, and administrators. Community priorities were tapped through parent forums.

Science programs used in surrounding and respectable school districts elsewhere were surveyed and these program reviews were reported. Materials available in the marketplace were also inspected. At the end of this first year of study, programs for pilot study were recommended for the subsequent year.

The rationale and goals set for the program are as follows:

Science education in elementary schools has often been relegated a low priority in terms of curricular attention and/or daily time allotments for instruction. The reasons for this unfortunate state of affairs may stem from teachers' own anxieties about the subject, fear of "not having the answers" to children's questions, an inordinate amount of time (in an already busy day) required to set-up for appropriate "hands-on" experiences, a curricular "eclipse" caused by overriding concerns about reading and mathematics instruction, or any combination of these or other factors.

The members of the Science Curriculum Study Group feel strongly and wish to assert that science instruction in our schools should be a priority concern and that the maintenance of a quality "hands-on" science program is absolutely essential if our youngsters are to be knowledgeable about and participate wisely in the rapidly changing technological society in which we live. This matter is much too important and therefore should not permit our tolerance of indifference, ambivalence, or the "step-child" status which science has often been granted in the elementary school curriculum. To this end, the following Rationale and Board Goals for Science Instruction have been advanced.

RATIONALE

Experiences in science are essential for the intellectual development of children. In science children ought to have a chance to handle, manipulate, and otherwise experiment with the materials of their physical and natural environment. In science children can begin to have the experiences that are the foundations of logical thought. It is becoming increasingly evident that these kinds of experiences

early in life are critical for optimum intellectual development.

Without such experiences, a child's education would be incomplete.

"Where are the stars in the daytime?"
"Where is the sun at night?"
"Why is the sky blue?"
"Why do all insects have six legs?"
"Where did I come from?"

These are but a few of the thousands of questions children ask sooner or later. Children have a natural curiosity about the world in which they live. Science may be thought of as the subject or discipline which aids children in their quest to know. But science is also humanity's quest to know. Science is the investigation and interpretation of events in the natural, physical environment. Scientists have studied the stars above our heads and the rocks at our feet. They have probed the atom and peered into the living cell. To a large extent they are asking the same kinds of questions as the curious child. They have learned much over the millennia, and all of us can benefit from it. No child needs to or can duplicate the work of thousands of scientists. The child can make use of what has already been learned. One of the purposes of science teaching is to help the learners tap the knowledge that has been accumulated and distilled over the ages. In Isaac Newton's words, the child too can "stand on the shoulders of giants."

INSTRUCTIONAL GOALS FOR SCIENCE

While science is one way in which we seek to interpret and understand the world in which we live, it is also a way in which each individual investigates and interprets. Thus, science is a matter of both the individual and humanity. Children will learn as a result of their natural curiosity. As they poke, pry, and explore, they will develop answers to some of their questions. But children will also learn from those who have inquired before. An important dimension of every child's science education is the opportunity to relate his or her developing view of the world with that which has been developed in the past. Our broad goals for science instruction, consistent with the goals for a Thorough and Efficient education as defined for the Tenafly Public Schools, may be summarized as follows:

1. To Build a Rational View of the Natural, Physical World.

As children participate in science experiences, they will explore the broad generalizations or "big ideas" which are basic to this discipline and, in fact, the very nature of our world. Children will develop their view of the world through their investigations of air and the atmosphere, matter and energy, astronomy, ecological relationships, the variety of living species, rocks, and minerals, etc. Through these investigations children will accumulate knowledge to build their world view.

2. To Develop Science Process Skills.

Certain basic process skills can be developed by children, and a command of these skills is an important asset in later inquiry-centered science studies. The following process skills are considered as basic to the

acquisition of scientific knowledge as is learning the sounds of the letters of the alphabet to the development of reading:

Observation
Sorting
Classification
Serial Ordering
Operational Definitions
Communicating Accurately
Hypothesizing
Predicting
Designing Experiments
Drawing Conclusions
Interpretation

3. To Gain an Understanding of the Major Concepts of Science.

We should help children to develop the broad generalizations that link together and explain the results of many experiments and observations. Among the many broad generalizations children should be exposed to are these examples:

There is a great variety of plants and animals in the world.
Plants and animals acquire adaptations to survive in diverse environments.
Living things develop interrelationships which help to support a variety of life forms together in close association.
Our bodies are organized according to various organ systems.
The earth's surface has undergone many changes during the course of time.
There are observable phenomena and events which may be explained by the physical laws of the universe.

These are but a few of the literally hundreds of major science concepts defined for science instruction.

4. To Develop Intellectual Power.

This goal can be achieved through science instruction. Intellectual power is the ability to logically:

-Interpret data and suggest patterns to explain data
-Suggest models to explain observations
-View phenomena from different frames of reference
-Use symbols and abstract ideas
-Suggest possible consequences for proposed actions, and build upon and apply past experiences.

Whether or not children develop these abilities depends to a large extent on the kinds of educational experiences they have. Certain science experiences may be essential for the development of this intellectual power. It is clear, too, that these abilities extend far beyond the domain of the subject matter of science, but assist in general education and indeed in a rational approach to life itself.

5. To Develop Scientific Literacy.

This may be defined as the ability to understand and discuss developments in science and technology as they are communicated via newspapers, magazines, television, and other public media. To be scientifically literate is to be able to participate in the explorations and new developments taking place in science and technology and to understand and be able to interpret some of the results of these investigations and their possible implications. We are exploring the solar system with ever more sophisticated space vehicles and the vast regions far beyond the solar system with large optical and radio telescopes. We are probing deeper into the atom, trying to get a clearer understanding of the nature of matter itself. In a myriad of ways we try to gain a better understanding of the nature of life and how it has evolved on this planet. These are the great intellectual adventures, and every youngster has a right to the preparation that will make it possible for him or her to participate in these adventures throughout a lifetime.

6. To Prepare for Responsible Citizenship.

Our children are citizens who have a great stake in what the adults in their lives do and don't do. Our children will live into the twenty-first century and will undoubtedly witness technological developments that will impact upon their lives. As educators, it is our obligation to prepare our youngsters to participate in the vital decisions they will face. During their lifetimes, the population of the world will almost certainly double and perhaps double again. Our environment and its resources will almost certainly be placed under great stress. Genetic engineering may be a boom or a bane. The creation of living tissue in a test tube will have profound practical as well as philosophical implications. Beyond this, our children will have to deal with developments we cannot foresee. Certainly, our children need an education with a strong background in science. H.G. Wells said, "Human history becomes more and more a race between education and catastrophe." For our children's sake, let us hope that the education we give them will ensure that the race will be won and that they will continue to be the winners.

ATTITUDINAL GOALS FOR SCIENCE

The following additudinal affective area goals for science instruction have also been identified:

1. To Foster the Development of an Inquisitive Attitude.

Children, by their very nature, are curious beings. They poke, pry, peer, and otherwise exhibit an intense interest in their environment. Through science instruction, we can endeavor to stimulate and promote this natural curiosity. We can help children to be open-minded, to respect the opinions and viewpoints of others, and be willing to alter a notion in the face of new evidence. We can help children gather evidence to test their assumptions and to seek reliable sources for evidence. Hopefully, the phrase, "Let's try it," will become commonplace in the child's vocabulary and the desire to experiment and explore will be supported and nurtured.

2. To Promote the Enjoyment of Work in Science.

Activities in science are fun! We would hope that our youngsters enjoy their involvement and continually seek answers to questions with a spirit of enthusiasm. Through experiences in science, children can develop an appreciation for the nature and variety of living things and a fascination with physical phenomena. We can promote children's self-confidence in the study of science by involving them in a variety of investigations. This can also enhance the child's self-concept. when we hear a youngster assert, "I can do it!", we know that we are helping him or her to feel competent as a learner. We can assure that each child will achieve a satisfactory level of success in science because exploring for exploration's sake is an aspect of every child's science education.

3. To Provide a Background for Lifelong Interest in Science.

As the amateur astronomer peers through a telescope, he or she often recalls the thrill of recognizing a constellation for the first time. Perhaps this early exposure occurred in an elementary school! Science activities help youngsters to derive personal satisfaction from their contacts with natural materials and understanding of phenomena. Positive science experiences, early in a child's schooling, may lead to a lifelong interest in science. Who can be more earnest than an avid bird watcher looking for that additional species to add to a life list? Interest in and appreciation of the wonders of science will lead individuals to participate in nature study, community involvement in environmental and conservation issues, and other leisure time endeavors which enrich the very quality of life.

The pilot projects proposed may be outlined as follows:

	School A	School B	School C	School D
Grades 1-3	SCIS-II	SCIS-II	SCIS-II	Concepts in Science Lab Program and Manuals
Grades 4-5	SCIS-II + ESS	SCIS-II	SCIS-II	Concepts in Science Lab Program and Manuals

Among the recommendations made to the Board of Education in May 1983, and supported unanimously by the Board, was the hiring of a Science Resource Teacher to provide professional and programmatic support for the reviewed efforts in science.

DESCRIPTION OF PILOT PROGRAMS

The three elementary school science programs piloted in Tenafly elementary schools may be described as follows:

SCIS-II

The SCIS-II revision of the original SCIS (Science Curriculum Improvement Study) program was considered far superior to the earlier SCIS version because of the clarity of its teacher guides and its improved equipment. This is by far the most popular "hands-on" elementary science program in the United States. It covers both physical and life science topics in a manner which is consistent with the nature and structure of science. Originally developed under the auspices of the National Science Foundation, this program remains one of the most conceptually "elegant" programs available.

The original SCIS program had been used in Tenafly for some fifteen years. (Our district was one of the original trial centers for development and refinement of the program.) In order to implement the program successfully, an active teacher support system and regular inservicing is necessary. This was the case in Tenafly's early utilization of SCIS, but with the loss of the science coordinator some eight or ten years ago, enthusiasm and support for the program waned and the materials (packaged as classroom kits) fell into a state of disrepair and disintegration.

As the Study Group considered the revised version of SCIS for pilot study in Tenafly, it became apparent that our inventory of old SCIS materials, which although rather disorganized, was plentiful in our schools, could be converted to SCIS-II and result in a considerable financial savings to the school system. The Science Resource Teacher spent several weeks during the summer converting our district's old SCIS kits to the newer, upgraded SCIS-II version. All of the science kits were brought to one of the schools where materials (literally thousands of small items) were sorted by like kind and then repackaged into new frames and boxes along with the Conversion Kits which are sold by Delta Education, Inc. to modify the older version. This teacher was assisted occasionally by Middle School students in this remarkable task. It is estimated that a savings of approximately $14,000 was realized by our conversion of materials on hand as opposed to purchase of brand new kits. The conversion process had the additional benefit of allowing the teacher to become thoroughly familiar with every vial, card, pump, thermometer, magnet, and other such materials which comprise the program.

Once the SCIS science kits were "rebuilt", they were distributed to the appropriate sites within the elementary schools and a storehouse of surplus materials to service and replenish the kits was established in the Maugham School basement.

CONCEPTS IN SCIENCE (LAB PROGRAM)
(Harcourt Brace Jovanovich)

After review of both the text and the laboratory programs of this series, it was decided that the lab program would best suit our needs. The new revised text (the Curie Edition) is over simplified and the concepts covered were considered superficial. The laboratory program, however, includes lab manuals incorporating reading material which is more challenging and more like the former, more demanding, edition of the textbooks (the Newton Edition). The laboratory program can "stand alone" and provide a rather sound science program without purchasing the textbooks.

One laboratory manual was purchased for each participating youngster and a few textbooks were acquired for each grade to serve as supplementary resources. The program has been on the marketplace for more than fifteen years (in various editions) and the lab program has been found to be quite successful in many school systems.

ELEMENTARY SCIENCE STUDY (ESS)

This program, published by both McGraw-Hill and Delta Education, is a collection of independent units. (Programs developed with Federal support are in the "public domain" and may be published by companies willing to produce the materials.)

The Elementary Science Study program is among the original "hands-on" discovery science approaches funded by the National Science Foundation. It was developed during the late 1950's and early 1960's by the Education Development Center in Newton, Massachusetts.

The units are designed to develop the fundamental skills necessary for organized scientific thought. Skills are developed in an atmosphere of investigation and discovery that makes learning an enjoyable experience.

The program has been extremely well tested and enjoys a very positive reputation in the scientific community.

Units from this very creative science program are being used to supplement the SCIS-II sequence at two of the elementary schools. The modular approach of ESS enables districts to pick and choose from among the 53 available units which comprise this program to suit individual and local needs. Units being piloted in Tenafly include:

Rocks and Charts (Grades 4 and 5)
Kitchen Physics (Grades 4 and 5)
Small Things (Grades 4 and 5)
Whistles and Strings (Grade 4)
Attribute Games and Problems (Grades 2 - 4)

The pilot plan also called for the establishment of an elementary science resource teacher to assist teachers on a daily basis as they developed "hands-on" science experiences for the youngsters. A vigorous inservice program was also recommended. It was felt that the above arrangement was well-suited to our needs in Tenafly as it provided a natural sequence from concrete experiences with material objects in the early grades to a greater degree of conceptualization and abstraction as the youngsters enter the intermediate grades. An evaluation mechanism was established. All of the above recommendations were approved by the Board of Education in June 1983.

Phase II of the curriculum renewal cycle, Pilot Studies, occurred during the 1983-84 school year. The major tasks accomplished during this pilot year included:

1. To see that all of the appropriate materials and kits were properly assembled, outfitted and in place in each of the elementary schools.
2. To provide summer workshops and other ongoing inservice opportunities to help the elementary school classroom teachers become familiar and comfortable with the science programs being piloted.
3. To provide direct daily assistance to teachers in classrooms or science labs as they move forward in science. This help has been provided primarily by the Elementary School Science Resource Teacher.
4. To replenish materials for science teaching as they are expended on an ongoing basis throughout the school year.
5. To provide advice to teachers in terms of the handling of materials and the development of effective techniques and strategies for science teaching.
6. To arrange for science assembly programs and to invite guest speakers, e.g. scientists, engineers, physicians, dentists, etc. into the schools to enrich and broaden our youngsters' understanding of science and the roles that scientists play in our community.
7. To suggest and coordinate the arrangements for trips to museums, planetariums, nature centers, and other appropriate field experiences.
8. To provide information for the community about our science programs as well as to convey current events in the larger world of science.
9. To evaluate and assess the pilot programs in science in terms of: pupil achievement, teacher opinion about the programs, teacher observation of changes in pupils' scientific attitudes, parental reactions, and pupil development and use of science process skills.

EVALUATION DESIGN

In order to assess the reactions to the various elementary school science pilot projects as well as the effectiveness of the teacher support program, a multi-faceted evaluation design was developed. The four basic components of the evaluative structure as well as the purpose for each is summarized below:

1. Science Objective Test.

After a review of several standardized science achievement tests, members of the Science Curriculum Study Group, felt that it would be best to assemble our own objective examination using items culled from standardized instruments. Science achievement tests are most often a part of larger achievement batteries and it seemed inadvisable

to have students take an additional test battery when the ERB Comprehensive Test Program is also administered in the Spring. (The ERB Program does not include a science sub-test.)

The test developed for use in Tenafly is composed of twenty questions which were selected from science sub-tests of standardized achievement batteries. The content of the questions does not necessarily follow any one of our three pilot programs, so they are equally fair (or "unfair") to all of the youngsters taking the test. However, the questions selected were more general than specific and ostensibly measure children's knowledge in the areas of physical and life science as well as problem solving, critical thinking, inductive and deductive reasoning, and investigative and research skills.

2. Teacher Questionnaire.
A questionnaire was developed to tap teacher reactions to the science pilot programs. Two types of information were sought: teacher assessment of growth witnessed in pupils as related to new science instructional practices, and teacher satisfaction with the level of professional support provided this year.

3. Parent Questionnaire.
This instrument, distributed to all pupils in grades one through five, was designed to discern whether or not parents have noted, at home, some of the effects of our science instructional practices. Free space for individual comments or remarks was incorporated into the questionnaire as well as an item asking for parents with special interests, talents, or abilities in science to identify themselves.

4. Science Process Test.
The processes of science are those skills, competencies, and behaviors exhibited by scientists as they inquire in laboratory situations. Such skills include: observing, classifying, defining, measuring, predicting, communicating, inferring, controlling variables, interpreting data, formulating hypotheses, experimenting, etc. This Science Process Test was designed to assess how well youngsters use these process skills to solve a problem posed to them. No standardized science process tests exist which would appropriately serve our purposes, but this is an area which we were very interested in evaluating, at last in a formative sense. (One such instrument came to the Study Group's attention via the International Science Study. The test was developed in Hungary, but for political and other reasons, could not be made available for use in the United States.) A rather involved test was first produced which would provide insight into how children might "layer" liquids of different specific gravities within a pipette (drinking straw). In field trials, this procedure proved too cumbersome.

Finally, a simpler test was devised which involved the comparison of single drops of two different types of liquid. One of the liquids, alcohol, was tinted blue with food coloring and the other liquid, water, was tinted red with food coloring. The student was asked to place a single drop of each liquid on a sheet of waxed paper. Using an eyedropper, the procedure was demonstrated for the student and then the student was asked to duplicate it.

This test was designed with a "built-in" practice effect so that each child was assured some degree of success with the eyedropper.

Water forms a bead which has a somewhat spherical shape on the waxed paper while alcohol is more flat and amorphous in shape when dropped on the waxed paper. Once the drops were placed on the waxed paper, the student was instructed as follows:

> "Investigate each of the drops very carefully. You may use any of the items here on the table: ruler, (inch/cm), eyedropper, magnifier. Make your observations and tell me about the size of each drop and any other observations that you can make as you compare the two drops on the waxed paper."

The results of this evaluative sequence were collected, tabulated, and reported. The findings and recommendations of the Study Group are summarized below:

1. Science education has witnessed a revitalization in the Tenafly Public Schools this year. Teacher, parent, pupil, and administrator comments support this conclusion. There has been broad-based acceptance and enthusiasm for the "hands-on" approach in science.

2. No apparent advantage of one pilot program over another was evidenced in terms of fourth grade pupil achievement on the Science Objective Test. It is noted, however, that Tenafly youngsters performed significantly better than pupils at the same grade level in a national sample.

3. The level of professional support to teachers was obviously a key factor in the success of the science programs this year. Teachers commented extensively on the role of the Science Resource Teacher as the principal reason for renewed enthusiasm and efforts in elementary school science. Teacher workshops, inservice courses, and the availability of materials were also appreciated.

4. A serious problem exists at the fourth grade level in the SCIS-II program. The content of the units is unusually abstract and there are not as many "hands-on" activities at this level as there are at other grade levels of SCIS-II. Representatives of the program manufacturer also admit a "weak spot" in fourth grade, but no plans for a revision are being made. Fourth grade teachers using the SCIS-II program expressed their discontent in the Teacher Questionnaires and coincidentally, the responses from parents of fourth grade children were also less positive at this grade level than that at others. The SCIS-II program at grade five is not as problematic as in the fourth grade, but teachers have noted that by grade five, SCIS-II becomes rather repetitive. It seems that a replacement for the SCIS-II program is needed for grades four and five. It was also concluded that any program(s) implemented in grades four and five ought to be consistent and compatible with the science program in grade six.

5. Teachers of grades four and five, while not seeking to use textbooks as the basis of the science program, did remark that a greater degree of conceptual learning would be appropriate for these grade levels than is currently the case.

6. Teachers of kindergarten through grade three indicated that the "hands-on" approach and the extensive use of concrete materials in pupil investigations is important and should be continued.

7. The establishment of elementary science labs was seen as a most positive feature in the two schools which maintained them this year, but some individuals expressed a preference for having their own classroom science kits. The need to share a kit at a grade level occasionally resulted in the partial depletion of materials and supplies by one class before the other class at the grade level could properly benefit from the experience. This may be averted by ordering a sufficient amount of extra consummable supplies for two classes. It was also noted that in the laboratory situation, it was sometimes difficult for a teacher to prepare for an upcoming lesson during the times when another teacher and class were occupied in the laboratory.

RECOMMENDATIONS

After reviewing the evaluative data and findings, members of the Science Curriculum Study Group developed a list of major recommendations for the implementation of an integrated science sequence in the Tenafly elementary schools and the sixth grade at the Middle School.

1. The Concepts in Science Laboratory Program (published by Harcourt Brace Jovanovich, Inc.) should be implemented at grades four and five at all four elementary schools.

2. The Concepts in Science program should be implemented at grade six in the Middle School. This will assure continuity with the fourth and fifth grade program in the elementary schools. Items to be purchased for the sixth grade program would be Classroom Laboratory Kits, one Laboratory Manual per pupil, and one associated textbook per pupil.

3. Units from the Elementary Science Study (E.S.S.), a particularly creative science program, should be used to supplement the Concepts in Science sequence in the upper elementary school grades. Such units were used as supplements in the 1983-84 school year.

4. The SCIS-II program should be maintained in grades one through three in the elementary schools. It is suggested, though, that implementation of this program at Mackay School be postponed until the 1985-86 school year because of a considerable unanticipated increase in the cost of science materials from Harcourt Brace Jovanovich and Delta Education, Inc., (the latter being the sole supplier of the SCIS-II program).

5. It is recommended that units from the E.S.S. program be installed in our all-day kindergarten programs. This will serve to enrich our youngest pupils' school experiences and also prepare them for the science work which is to follow in the early elementary grades by providing them with a rich foundation of manipulation of concrete materials. The units suggested for kindergarten are: "Attribute Games and Problems," "Pattern Blocks," and "Growing Seeds."

6. The level of professional support to teachers should be maintained. The role of the Science Resource Teacher is vital to the science programs.

7. Elementary school science labs ought to be established in the buildings in which the space is available. Despite some drawbacks mentioned previously, (e.g. the need for two classes to share a single set of materials and equipment), it was felt that the enthusiasm which occurs within a school by the creation of a special room for science instruction far outweighs the identified drawbacks.

8. The commitment to community involvement in the science program should be maintained and augmented. Newsletters, guest speaker appearances, and parents with scientific interests and backgrounds spending time in schools with youngsters all add strength to the program and should be encouraged and supported. Field experiences have also proven to be enriching for the youngsters and it is suggested that teachers on specific grade levels within the district ought to coordinate field trips and share pre-planning and follow-up activities.

9. It is further recommended that the commitment to providing inservice opportunities for teachers be maintained and expanded. Advanced workshops for teachers who have used the SCIS program for a number of years should be provided so that new ideas may emerge and refined teaching techniques developed. A summer, or early fall, workshop is suggested for fourth and fifth grade teachers who will be using the Concepts in Science program.

10. In future years, additional SCIS-II and Concepts in Science kits should be purchased with the goal of eventually providing one kit for each class on a grade level rather than one kit per grade level.

11. The current recommended standard time commitment of two forty-minute science laboratory experiences per week in the elementary grades should be continued. In kindergarten and grade one, thirty minute periods may be more appropriate.

Several reasons were cited to support the recommendations set forth above. One of the prime factors for the retention of the SCIS-II program in grades one through three and the proposed change to the Concepts in Science Laboratory Program in grades four and five, is the firm belief that young children ought to be provided with a wealth of first-hand experiences with materials from their physical and natural environments. Young children also need to learn how to collect and organize data to support hypotheses and form conclusions. The SCIS-II program stresses and allows for many such experiences. As children enter the intermediate grades, however, they are ready for a greater degree of conceptualization and content orientation as is provided in the Concepts in Science program. This sequence of intellectual

maturity (i.e. concrete experiences preceding more abstract ones) is consistent with major tenets of cognitive psychology.

The Concepts in Science program in grades four and five will also allow for greater continuity and articulation between elementary and middle school science experiences since this same program has been selected for grade six. The implementation of the Concepts in Science program in grades four and five also addresses a rather pervasive concern about the weakness of the SCIS-II program at the fourth grade level and the undue repetitiveness of this program at the fifth grade level. All of these recommendations were approved by our Board of Education in May 1984.

Phase III of the curriculum renewal cycle involves implementation of the adopted program. The newly-established program must undergo a rather comprehensive evaluation and then programmatic adjustments, if necessary, are made for the ensuing years. The current school year, 1984-85, represents Phase III of this cycle and the objectives to be completed for this year are as follows:

1. To implement the specific programs recommended by the Study Group in May 1984.

Kindergarten	Elementary Science Study units
Grades One to Three	SCIS-II
Grades Four and Five	Concepts in Science Laboratory Program

2. To assess the level of success associated with the implementation of the above-mentioned programs in terms of:
   - -pupil achievement according to criteria established
   - -teacher assessment of pupil growth, ease of set-up and general satisfaction with programs
   - -parental reaction

3. To continue in the efforts to support teachers in their science instructional practices and techniques.

4. To provide in-service opportunities for teachers in elementary school science.

5. To implement the recommended time commitment of two 45 minutes of "hands-on" science per week in each grade.

6. To continue to inform and involve the community-at-large in the elementary school science program.

7. To develop a curriculum document for science in grades K-5, consistent in format with other such documents which have been developed in the school district.

8. To develop a descriptive brochure about our elementary school science programs.

A periodic newsletter, SCIENCE ALERT, has been established to inform parents and other community members about local, national, and international events in science. (Samples of these newsletters appear in Appendix A and Appendix B.)

Once the adopted programs are in place, the life of these programs is considered to be approximately five years. The curriculum committee however, remains intact to deal with problems as they arise and to infuse current ideas into the ongoing program.

III. PROGRAM EVALUATION

A multi-facted program evaluation mechanism has been established, which is quite similar to that which was utilized to assess the effectiveness of the pilot programs in Phase II. (See pp. 34 through 48 in Appendix G.)

A. Science Objective Test. The appropriate level of the Science sub-test of the Metropolitan Achievement Test is to be administered to all fourth grade pupils. The average percent passing each item will be compared with the national norms for these test items. The goal in Tenafly is for a mean of percent passing an average of all of the test items which will exceed 75 percent. These results will be compared from year to year to discern whether any identifiable trends exist.

B. Teacher Questionnaire. Three questionnaires were developed to assess teacher reactions to the programs implemented. One questionnaire is for Kindergarten teachers using the E.S.S. program (See Appendix C). The second questionnaire is for teachers of grades one, two, and three who are using the SCIS-II sequence (see Appendix D). The third teacher questionnaire is for teachers of grades four, five, and six who are using the Concepts in Science program (See Appendix E).

C. Parent Questionnaire. This instrument, distributed to parents, is designed to discern whether or not parents have noted, at home, some of the effects of our science instructional practices. Free space is incorporated into the questionnaire for individual comments. (See Appendix F.)

IV. NEEDS TO MAINTAIN THE PROGRAM

Annual budgetary allocations for replenishing science kits and acquiring live materials will be a continuing requirement. We are also trying to provide each teacher with his/her own science kit rather than having two teachers on a grade level share a kit. The members of the Science Curriculum Study Group are also recommending the maintenance of the position of Elementary Science Coordinator in order to provide the ongoing support needed for teachers as they embark upon new approaches in science.

So far as the curriculum renewal cycle is concerned, this aspect can be

maintained without additional funds so long as teachers and administrators continue to have the will to examine and improve curriculum practices on a regular, systematic basis.

V. CHANGES

The only change desired at this point is for an expansion of units available to our kindergarten classes. In Tenafly, all-day kindergartens were instituted during the 1984-85 school year. With increased instructional time available, it is desirable to provide additional E.S.S. units at this grade level.

As mentioned previously (in section IV), it would also be desirable to provide one science kit per teacher rather than one per grade. This would eliminate some of the difficulties associated with two teachers sharing a single set of materials.

EVALUATION

Phase III of the curriculum renewal cycle cannot be evaluated at the time of this writing because the collection of data will not be completed until June 1985. Included, though, as Appendix G, is the complete text of the Phase II evaluation, taken from the Report of the Science Curriculum Study Group for the evaluation of pilot programs in May 1984.

SCIENCE alert
News of Children & Science in Tenafly
Vol. 1, No. 1 Fall 1983

First Issue

NOTES FROM THE EDITOR

SCIENCE ALERT is a newsletter intended to highlight current information about science happenings in Tenafly Elementary Schools and the outside world. Each issue will feature activities in our schools, suggested home experiences, and newsworthy events in the larger area of science in our lives.

This year, Superintendent of Schools Harry Jaroslaw and your Board of Education have approved a massive effort to revitalize science education in our schools. New or revised programs have been installed in each elementary school. Maugham, Smith,

continued on page 3

Current Events

ATOMS SEEN FOR FIRST TIME!

The first pictures of an atom within a solid can now be seen by using an ARM, an Atomic Resolution Microscope. The ARM operates at lower voltages than previous models of electron microscopes and produces a clearer picture of the atom. Up until now pictures produced by earlier electron microscopes were only glimpses of the atom. Atoms in ARM micrographs appear as black and white dots on a gray background.

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SCHOOL NEWS

Peter J. Donatella
Science Resource Teacher

Curiosity and excitement abound! The following examples illustrate what is happening. While investigating a sifting mixture of sand, salt and baking soda, GUS ORNSTEIN, a third grade Maugham School student, described their physical properties this way: "The sand looks dull; the salt sparkles; the soda is powdery." RICKY ALLENDORF, a fifth grader at Stillman School, found that water drops on waxed paper leave spots which could create a design. CLAUDIA RIZZO, another fifth grader at Stillman, found that a drop of water on waxed paper has a spherical shape. KEVIN ESKRIDGE, in Mrs. Weldon's first grade at Mackay, asked why the bean seed is so large if the embryo is so small. He was looking at the tiny leaf and root system inside the bean seed. WASSIM BEYDOUN, a fourth grader at Smith School, was thrilled when he produced a sound with a paper drinking straw; then he found he could raise the sound's pitch by shortening the straw.

It would be a pleasure to tell about each and every investigation and discovery made in all our schools. This section of SCIENCE ALERT will report as many items of this nature as space will allow.

2

DID YOU KNOW ?

DID YOU KNOW. . . that the letters in LASER stand for Light Amplification by Stimulated Emission of Radiation? A laser is a thin beam of light which can be controlled to measure, cut, and transmit power as well as many other things. Lasers come in many colors and sizes. They can be transparent or ruby-red or yellow or purple as well as many other colors. The light beam may be as small as a grain of salt or as long as a football field.

CURRENT EVENTS

continued from page 1

The ARM was designed and built in Japan by the Japanese Electron Optical Laboratory. It occupies three floors of a building. The top floor is where the accelerator that generates the high speed electrons is located. The middle floor is where the microscope or lens is kept. The lens focuses electrons onto the specimens. The bottom floor consists of a series of springs that float on air—filled rubber tubes. This supports the entire instrument and is called the "vibration isolation system."

Seeing an atom should be a great help in developing new and improved products. For example, being able to see one atom will allow the researcher to find imperfections and make improvements in a microchip that is very small. One atom that has an imperfection can disrupt the entire program for that chip. Biophysicists are also using the new microscope to study how proteins operate on the sides of membranes of a cell.

DID YOU KNOW. . . that 1983 is the bicentennial of people in flight? It was 200 years ago, on November 21, 1783 that two Frenchmen, Jean Francois Pilatre de Rozier and Francois-Laurent d'Arlandes, first climbed into a balcony-like structure connected to a hot air balloon. They were in the air for 25 minutes and traveled 10 km across Paris. This first balloon was developed by two brothers, Joseph and Jacques Etienne Montgolfier.

NOTES
continued from page 1

and Stillman Schools are using an updated, thoroughly revised version of the nationally known Science Curriculum Improvement Study program. Originally developed under the auspices of the National Science Foundation, this program emphasizes "hands-on" experiences to promote the acquisition of basic science knowledge, develop investigation skills, and cultivate a positive attitude toward science.

This program will be supplemented in the upper grades at Maugham and Stillman Schools by units from the very creative Elementary Science Study program.

At Mackay School, students and teachers will work with the "Concepts in Science" Laboratory Program published by Harcourt Brace Jovanovich. This program incorporates a wealth of investigations to "make science real" for the students. Centered around key scientific concepts the program is also designed to develop important skills such as observing, testing and measuring.

Elementary school science labs have also been established at Maugham and Mackay.

The second, and perhaps most important feature of our new efforts in science, is direct daily assistance to the elementary school teachers. Peter Donatella, a veteran elementary and middle school teacher, is serving as an Elementary Science Resource Teacher this year. He maintains the new science lab at Maugham School and provides ongoing assistance in science to teachers in all four schools both in terms of instructional techniques and in equipment and resource utilization.

An energetic in-service program is also underway. More than half of the district's elementary school teachers participated in Science Workshops this summer and in-service courses and guest speaker appearances are occurring this fall. For example on October 10th all elementary school teachers were involved in an all day workshop called "Inquiry: An Approach to Teaching and Learning." Among the workshop speakers was Willard Jacobson, professor of Natural Sciences at Columbia University and national research coordinator for the International Science Study. The teachers gleaned a great deal from this experience; however, the youngsters will be the ultimate beneficiaries.

Our youngsters may seem to be developing a greater curiosity about their environment. Let's support their inquiry and help them find the answers to their endless questions about their world.

So, read on! Familiarize yourself with the various departments in SCIENCE ALERT and keep your fingers on the pulse of science.

Abby B. Bergman
Maugham School Principal

A FAMILY NIGHT OF INVENTION

On November 16th from 7:00 p.m. to 9:00 p.m. in the High School, the Young Inventor's Club will present a special meeting open to all students and their parents. The multi-image show, "Irv Koons: the Man and His Art, a Retrospective," and live on stage, "The Invention of Magic," will illustrate inventiveness in the design of packaging and the creation of illusion. These informative and entertaining presentations will stress the steps in the creative thought process and the development of an idea. Brochures are available in your school office and have also been taken home by the students.

SPECIAL THANKS TO. . .

. . . Jim Brown who developed the graphic design for SCIENCE ALERT

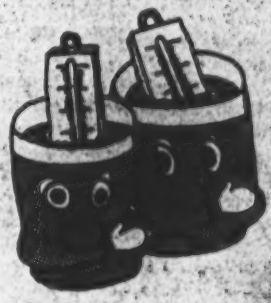
. . . Maryanne Fulco for her time spent on some of the art work in this issue

. . Mr. Durelle for his art work.

Do At Home

HOW MUCH WARMER DO THINGS GET IN THE SUN THAN IN THE SHADE ?

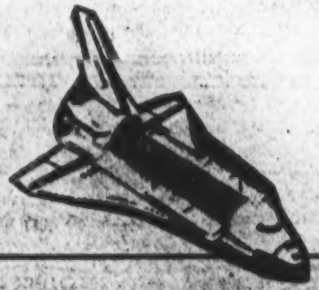
Pour equal amounts of cold water into 2 styrofoam cups. (the colder the better!)



Place a thermometer in each cup.

Set one in the sun and the other in the shade. What is the temperature of each after 5, 10 and 15 minutes ?

SCIENCE alert
News of Children & Science in Tenafly



VOL. 2, NO. 1 WINTER 1984

NOTES FROM THE EDITOR

As we move into the districtwide adoption of our new elementary science program, it is important to answer again the basic question, "Why are we devoting time to science when so much effort is needed in the important areas of reading, writing, and arithmetic?"

These basic skills are vital and essential; however, without a strong background in science our youngsters will probably be ill-equipped for a world increasingly dependent upon modern technology.

In addition, research has shown that "hands-on" science experiences improve pupil achievement in reading, mathematics, and critical thinking skills. Furthermore, science study

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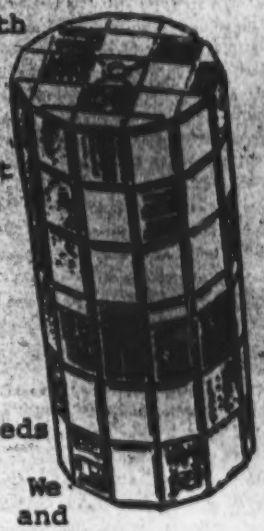
Current Events

A NEW SOLAR SYSTEM?

Astronomers at Carnegie Institution's Las Campanas Observatory in Chile have viewed what they think might be a new solar system in formation! Photographs of Beta Pictoris, a nearby star, reveal a thin, disk-shaped cloud of dust orbiting the star, suggesting that planets are beginning to form around it.

continued on page 2

DID YOU KNOW ?



. . . That Tenafly fifth and sixth graders will experiment with tomato seeds that have traveled 10 months in a space capsule? As part of the space shuttle - CHALLENGER mission in April 1984, 14 million seeds were placed in a low-Earth orbit in the Long Duration Exposure Facility, called LDEF, pictured on the right. Once retrieved, the seeds will be distributed to classrooms nationwide. We have reserved 50 seeds and will design our own experiments to study how "space" seeds and "earthbound" seeds differ in the way they germinate and grow.

SCHOOL NEWS

How many men work in the mine at one time? What do we use zinc for today? Are all the rocks fluorescent here in Franklin, N.J.? Mr. Donatella, how many rocks may I take home?

These were among the many questions heard during a recent fifth grade field trip to the Franklin Mineral Museum and Buckwheat Dump. The children from Maugham and Stillman Schools brought back many outstanding samples of calcite, willemite, and dolomite as well as Franklinite, the only mineral which does not glow or look fluorescent under an ultraviolet light.

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NOTES
continued from page 1

stimulates in youngsters an appreciation of fascinating phenomena in their environment as well as an awareness of the beauty and delicacy of nature.

Fundamental to the education of our students, also, is the role of science in preparing them for responsible citizenship. These children will live in the 21st century and need to be ready to participate in its technological challenges and decisions.

They will need to address issues such as genetic engineering, the population explosion and the use of environmental resources. There are sure to be still other developments that we cannot begin to foresee, which our youngsters will need to face.

Certainly our children require an education with a strong background in science, as well as an understanding of how scientific research is conducted.

H. G. Wells said, "Human history becomes more and more a race between education and catastrophe." For our children's sake, let us hope that the race will be won and that they will continue to be the winners.

Abby B. Bergman,
Maugham School Principal

Current Events

continued from page 1

Beta Pictoris, which is 50 light years away from the Earth, is twice the mass of our own sun and would be ten times as bright as our sun if it were at the center of the solar system.

OLDEST REPTILE FOSSIL FOUND!

Geologists believe that they have uncovered a fossil of the tracks of the most ancient reptile. Impressions found in the mountains of Kentucky reveal that the animal tracks were apparently left by a four-legged, five-toed reptile, in mudflats more than 310 million years ago.

The animal was probably about 15 inches long and its feet were huge in proportion to the rest of the body. These fossils are the oldest known evidence of reptiles found in the world.

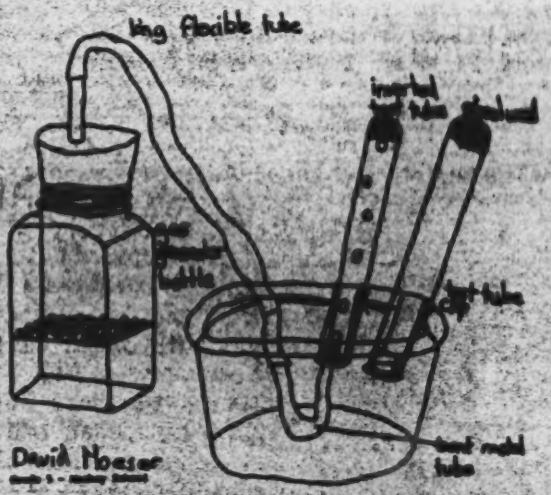
SCHOOL NEWS
continued from page 1

Mackay School fifth graders have been studying local rock formations and developed a comprehensive collection of rocks and minerals for their classrooms. Smith and Stillman School fifth graders hunted fossils in the shale that lines the railroad tracks in Tenafly and brought back many dramatic examples for further study. This shale contains an abundant variety of plant and animal fossils. (Please make sure that your child does not revisit the area of the tracks without adult supervision!) These initial units, dealing with minerals, rocks, and fossils, are components of the new science programs being used in our schools this year.

continued on page 3

DID YOU KNOW ?

DID YOU KNOW. . . In the front yard of the Canciglia family home at 118 Engle Street in Tenafly, there is a very special tree. It is called a Kentucky Coffeetree (Gymnacladus dioicus), and it is listed in New Jersey Outdoors as a record-holding tree. It has a circumference of 12 ft., 8 in. You may want to visit this giant during the winter, and again in the spring when many white blossoms form. We are told by Joseph Canciglia that the blossoms can be boiled, making a brew that has the flavor of coffee.



Fifth graders have conducted an investigation demonstrating how metal can combine with oxygen. In this experiment students generated pure oxygen which interacted with steel wool to form rust. David Moeser, a Mackay School student, drew a picture of his laboratory set-up (above).

MORE SCHOOL NEWS
continued from page 2

In our kindergartens, the youngsters are involved with three units from the very creative Elementary Science Study (E.S.S.) program. In a unit called "Attribute Games and Problems" our youngest pupils identify, classify, and define relationships using concrete objects. They identify shapes, colors, and sizes and arrange objects into groups or subsets by considering various attributes and values. Seasonal studies and seed investigations will also be conducted.

The Science Curriculum Improvement Study (SCIS-II) program is being implemented in grades one through three. This very stimulating "hands-on" program involves pupils in a variety of meaningful activities designed to promote scientific literacy, investigative skills, and critical thinking.

As children enter the upper elementary school grades and grade six in the Middle School, they are involved in the Concepts in Science laboratory program. Major scientific concepts are developed through experiments and demonstrations. An example of such an experiment is shown above.

This natural progression from concrete, "hands-on" experiences to a greater degree of conceptual development is consistent with sound learning theory and our knowledge of child development.

Peter J. Donatella
Elementary Science
Coordinator

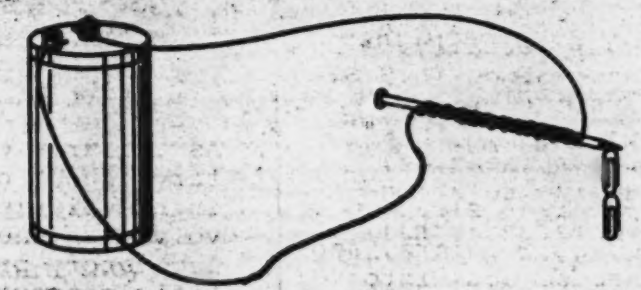
Do At Home

MAKE AN ELECTROMAGNET

MATERIALS:
Insulated wire (about 2-3 meters)
Iron or steel nail or bolt
Dry cell or battery
Paper clips

WHAT TO DO:

1. Wrap the insulated wire tightly around the nail or bolt. (Wrap in one direction only.)
2. Attach the ends of the wire to the poles of a dry cell. (If you use an ordinary battery, the ends may be attached to the poles of the battery with a thick, tight rubber band.)
3. Touch one end of the electromagnet into a pile of paper clips. Are the paper clips attached to the end of the electromagnet?
4. What other materials will the electromagnet pick up?
5. What happens when you detach one of the wires from the dry cell or battery?



GOING FURTHER: Study the relationship between the number of turns in the wire coil and the strength of the electromagnet. See how many paper clips can be held in a chain at the end of the electromagnet. Now increase the number of turns in the wire coil. Does this affect the number of paper clips that can be held in a chain?

GOING STILL FURTHER: We would like to report on your activities in the next issue of SCIENCE ALERT: Design an experiment using your electromagnet. Demonstrate your investigation to your class, write a report about it, and submit to: Mr. Peter J. Donatella, Science Coordinator, in care of your classroom teacher.

TENAFLY PUBLIC SCHOOLS
TENAFLY, NEW JERSEY

Dear Kindergarten Teacher,

We are very much interested in your assessment of our science programs this year. Please take the time to complete this questionnaire and return it to the Science Curriculum Study Group member in your school by April 4, 1985.

Your cooperation is appreciated and will help us in our program evaluation and future planning in science.

Sincerely,

THE SCIENCE CURRICULUM STUDY GROUP

1. Which units from the E.S.S. science program did you accomplish with your kindergarten class this year?_____

_____

2. Please list some of the other topics or activities you accomplished in science this year which were not a part of the E.S.S. program.

_____ _____

_____ _____

_____ _____

3. Have you been satisfied with the science program you have implemented this year in terms of:	NOT AT ALL	MODERATELY SO	VERY MUCH
a) content and concepts?			
b) personal value or enjoyment?			
c) ease of set-up?			
d) professional support?			
e) pupil growth in science?			
4. After reviewing the unit objectives, as stated in the curriculum guides, to what extent do you feel your pupils have obtained the objectives for the various units implemented?			
5. To what extent do you feel that the science experiences enhanced the all-day kindergarten program?			

6. Suggestions for improvement or future directions:_____

_____

_____

NAME_____ SCHOOL_____

TENAFLY PUBLIC SCHOOLS
TENAFLY, NEW JERSEY

Dear Teachers of Grades One, Two, and Three,

We are very much interested in your assessment of our science program this year. Please take the time to complete this questionnaire and return it to the Science Curriculum Study Group member in your school by April 4, 1985.

Your cooperation is appreciated and will help us in our program evaluation and future planning.

Sincerely,

THE SCIENCE CURRICULUM STUDY GROUP

Which science program(s) have you used with your class this year? _____

PLEASE CHECK THE APPROPRIATE COLUMN:

	NOT AT ALL	MODERATELY SO	VERY MUCH SO
1. Have you noticed increased curiosty or interest in science on the part of your pupils?			
2. Have you noticed an increased desire on the part of your pupils to extend an idea beyond a lesson presented?			
3. Have you noticed growth in your youngsters' level of application and persistence in science?			
4. Do you believe that the science program helped to promote independent or critical thinking on the part of your pupils this year?			
5. In this second year of using a new or revised science sequence, have you been satisfied with the program in terms of:			
a) content and concepts?			
b) organization of program at your grade level?			
c) availability of materials?			
d) ease of set up?			
6. Have you been satisfied with the level of professional support in science this year?			

(over)

Please answer these additional questions which are essential elements of our program evaluation:

1. After reviewing the specific objectives for the science sequence, as stated in the teacher guides, what percentage of the pupils in your class do you feel have attained the stated objectives of the program? Base your response upon your own observations, questions answered during lessons, teacher made tests and quizzes, and publisher-defined evaluative materials. Please check one box.

Less than 50%	60% of pupils	70% of pupils	80% of pupils	90% of pupils	more than 90%

2. Please estimate how much class time (in minutes per week) you have devoted to science instruction this year. Include hands-on, reading, spontaneous, and field experiences in your estimate.

   An average of _____ minutes per week.

3. Suggestions for improvement or future directions: _____

_____

_____

_____

_____

_____

NAME _____ GRADE TAUGHT _____

SCHOOL _____

TENAFLY PUBLIC SCHOOLS
TENAFLY, NEW JERSEY

Dear Teachers of Grades Four, Five, and Six,

We are very much interested in your assessment of our science programs this year. Please take the time to complete this questionnaire and return it to the Science Curriculum Study Group member in your school by April 4, 1985.

Your cooperation is appreciated and will help us in our program evaluation and future planning in science.

Sincerely,

THE SCIENCE CURRICULUM STUDY GROUP

PLEASE CHECK THE APPROPRIATE COLUMN:	NOT AT ALL	MODERATELY SO	VERY MUCH SO
1. Have you noticed increased curiosity or interest in science on the part of your pupils?			
2. Have you noticed an increased desire on the part of your pupils to extend an idea beyond a lesson presented?			
3. Have you noticed growth in your youngsters' level of application and persistence in science?			
4. Do you believe that the science program helped to promote independent or critical thinking on the part of your pupils this year?			
5. Since you are using the Concepts in Science Laboratory Program this year, have you been satisfied with this science program in terms of:			
a) content and concepts?			
b) organization of program at your grade level?			
c) availability of materials?			
d) ease of set up?			
6. Have you been satisfied with the level of professional support in science this year?			

(over)

Please answer these additional questions which are essential elements of our program evaluation:

1. After reviewing the specific objectives for the science sequence, as stated in the teacher guides, what percentage of the pupils in your class do you feel have attained the stated objectives of the program? Base your response upon your own observations, questions answered during lessons, teacher made tests and quizzes, and publisher-defined evaluative materials. Please check one box.

less than 50%	60% of pupils	70% of pupils	80% of pupils	90% of pupils	more than 90%

2. Please estimate how much class time (in minutes per week) you have devoted to science instruction this year. Include hands-on, reading, spontaneous, and field experiences in your estimate.

   An average of _____ minutes per week.

3. Suggestions for improvement or future directions: _____

_____

_____

_____

_____

_____

NAME _____ GRADE TAUGHT _____

SCHOOL _____

TENAFLY PUBLIC SCHOOLS
TENAFLY, NEW JERSEY

Dear Parents,

We have continued our efforts to renew and revitalize our science instructional programs in grades K through 6 this year. New or revised programs have been installed at the kindergarten, fourth, fifth, and sixth grade levels. We are interested in the extent to which science learnings in the school have been reflected at home. Would you kindly take the time to answer the questions below and return the completed form to your child's teacher by April 4, 1985. This information will assist us in our evaluation of our new science programs.

Your cooperation is appreciated.

Sincerely,

THE SCIENCE CURRICULUM STUDY GROUP

	YES	NO
1. Has your child related to any of the specific science experiences he or she has had in school this year?	☐	☐
2. Have you noticed an increase in your child's interest in science?	☐	☐
3. Do you believe that science has received adequate emphasis in our schools this year?	☐	☐
4. Has your child conducted any science experiments at home?	☐	☐
5. Do you believe that an increased level of science experiences in the elementary schools is important in preparing children for the challenges of an increasingly technological society?	☐	☐

Any comments or remarks would be appreciated: _____

_____

_____

_____

NAME _____ GRADE LEVEL(s) OF YOUNGSTER(s) _____

SCHOOL _____ _____

RESULTS OF EVALUATIVE STUDIES

A great deal of information regarding the impact of our science programs was collected and analyzed. The members of the Science Curriculum Study Group spent many hours sifting through the data obtained from the various evaluative devices. Since it would be impractical to report all data and responses collected, the following is a summary of the findings from each of the four main assessment tools:

1. Results of the Science Objective Test

The Science Objective Test was not designed to measure pupil retention of material covered in the specific pilot projects, but rather, it is an assessment of general knowledge in selected areas of physical and life science as well as problem solving, critical thinking, inductive and deductive reasoning, and investigative and research skills. However, the results do indicate that for the test items administered, Tenafly fourth graders significantly outperformed their counterparts when compared with a national sample of other fourth grade pupils.

Among Tenafly youngsters, however, there was no perceptible difference in performance from school to school. The test results are summarized in Table I.

Examination of the test results reveals that a higher percentage of Tenafly students passed each and every test item when compared with the National sample. The range of percent passing elevations (Tenafly compared with national norms) was from 6 to 37 percent.

The school averages indicated at the bottom of Table I, demonstrate that the average percent passing items on the test was extremely close for all four Tenafly elementary schools, i.e. Mackay, 80%; Maugham, 82%; Smith, 82%; Stillman, 81%. The Tenafly average was 81.50% as compared with an average percent passing of 60.25% in the national sample.

TABLE I

PERCENT PASSING TEST ITEMS BY SCHOOL ON THE FOURTH GRADE SCIENCE OBJECTIVE TEST

ITEM NO.	MACKAY n=25	MAUGHAM n=35	SMITH n=32	STILLMAN n=41	TEMAFLY AVERAGE n=131	NAT'L. PERCENT PASSING	DIFFERENCE
	(n = number of children taking test)						
1	100	94	100	93	96	82	+14
2	84	100	88	95	93	70	+23
3	92	100	97	95	96	76	+20
4	92	89	88	91	90	73	+17
5	84	83	97	89	88	62	+26
6	72	80	94	73	79	42	+37
7	56	60	88	64	67	40	+27
8	16	6	47	16	21	15	+ 6
9	96	91	91	91	92	76	+16
10	96	97	94	95	96	87	+ 9
11	88	94	84	93	90	63	+27
12	88	91	66	84	82	61	+21
13	92	83	81	77	82	60	+22
14	56	71	69	61	65	43	+22
15	60	71	56	70	65	39	+26
16	96	100	91	95	96	76	+20
17	64	60	47	59	57	47	+10
18	96	97	94	95	96	71	+25
19	88	83	81	93	89	60	+27
20	92	94	88	93	92	62	+30
Averages	80	82	82	81	81.5	60.25	+21.25

2. Results Obtained from the Teacher Questionnaire

All elementary school classroom teachers in grades one through five returned the Teacher Questionnaire to their building Science Study Group representative. Table II shows the results of the teachers' responses. Examination of this table reveals that in most instances, teachers noticed an increase over previous years in the following areas: pupil curiosity and interest in science, pupil desire to extend ideas beyond a lesson, degree of independent or critical thinking, and youngster application or persistence.

More than half of the respondents indicated that they have spent more time teaching science this year than in previous years. There is no question that the teachers perceived a greater level of professional support this year over previous years as evidenced from their responses to question 7.

In analyzing the individual responses to question 6, it became apparent that the greatest degree of dissatisfaction with the science program this year emerged from teachers of fourth grade who used the SCIS-II program. It is also noted that the most positive responses to the program occurred at Mackay School where teachers have been piloting the Concepts in Science Laboratory Program. Ninety percent of the Mackay School teachers were more satisfied with the content and concepts covered in this program as compared with their use of the SCIS program in previous years. One hundred percent of the respondents indicated that the Concepts in Science program was better organized, easier to set up, and the materials were more readily available than in other elementary science programs used in the past.

The greatest level of teacher satisfaction with the SCIS-II pilot, occurred among teachers of grades one through three. These individuals remarked about the appropriateness of the "hands-on" approach of the SCIS-II sequence and how they felt it met their children's needs in science and other areas. The heavy emphasis upon the manipulation of concrete objects and materials is seen as a very real advantage of this program, especially in the lower grade levels.

With regard to specific comments as written on the reverse side of the Teacher Questionnaire (See Appendix-E), the following summaries are provided:

(Text continues on p.38)

TABLE II

TALLY OF RESPONSES TO THE TEACHER QUESTIONNAIRE IN SCIENCE, PART I
(Teachers of Grades One Through Five)

	NUMBER OF RESPONSES IN EACH CATEGORY		
	Less Than In Previous Years	No Change	More Than In Previous Years
1. Have you noticed an increased curiosity or interest in science on the part of your pupils?	1	10	23
2. Have you noticed an increased desire on the part of your pupils to extend an idea beyond a lesson presented?	1	10	23
3. Have you noticed a change in the degree of independent or critical thinking in science on the part of your pupils this year?	0	14	20
4. Have you noticed growth in your youngsters' level of application and persistence in science?	0	13	21
5. Has there been a change in the amount of time you spend teaching science this year?	0	15	19
6. Have you been satisfied with the science program you have used this year in terms of:			
a) content and concepts?	3	11	20
b) organization of program at your grade level?	2	11	21
c) availability of materials?	4	3	27
d) ease of set up?	4	9	21
7. How would you characterize the level of professional support in science this year?	0	2	32

Science Support Personnel. All responses were overwhelmingly positive. Teachers felt that the role of the Science Resource Teacher was the key ingredient for the resurgence of interest and effort in elementary school science this year. Some sample comments follow:

"Wonderful! It's terrific to have someone to rely on for ideas and material. I've learned a lot from watching Pete (Mr. Donatella) teach."

"Pete has been a wonderful help in both understanding teachers' problems and supporting their needs."

"Outstanding both at the initial stage and throughout the curriculum."

"The science program was well-supported by Dr. Bergman and Mr. Donatella - both helped a great deal."

"Mr. Donatella has given total support to my program. He has helped me through experiences and suggested methods. Missed his support greatly when he was ill!"

Workshops and Inservice Courses. Most teachers remarked that the summer workshops were very helpful. The majority thought that the October 10th workshop was quite stimulating. A few individuals remarked that the inservice course conducted by professors from Fairleigh Dickinson University was not as useful as they would have hoped. Some sample remarks follow:

"The Fall Professional Day with Dr. Jacobson was enjoyable and informative. The F.D.U. inservice program was not as specific to the curriculum as one would hope."

"The summer workshop was extremely helpful."

"The session at Mackay before the opening of school was very helpful in terms of setting up my kit. The kit is very well organized - a big help."

"Helpful, but somewhat repetitive for those who have been working in SCIS for a number of years."

Overall Reaction to the Instructional Program This Year. The overall reaction to the science program this year was "enthusaistic" to quote one teacher. At Mackay School most teachers preferred the Concepts in Science Program as compared to their former use of SCIS. A few teachers at Mackay remarked that the kits did not include a sufficient amount of materials for two classes at a grade level. Sample remarks follow:

"The kids have enjoyed it. They look forward to our science times - and so have I. We've all learned a lot this year, too!"

"The Concepts in Science program was a pleasure to teach. The lessons were new ideas to the children."

"The new SCIS-II guidebook is better than before. The help is available and materials are available. Therefore, it's easier to teach."

"While the fourth grade SCIS-II program seems lacking in content and "hands-on" experiences, other supplementary programs were available, e.g. the E.S.S. kits - Small Things and Batteries and Bulbs, the Nature Center."

Suggestions for Improvement and Future Directions. Several teachers remarked that the economy measure of sharing one kit on a grade level proved to be difficult for them. There seemed to be a preference for an individual kit in each classroom. Also, the lack of running water in classrooms or labs was seen as a drawback. Sample remarks follow:

"I hope that the new SCIS-II will be used in first grade. It is most appropriate to the development and interests of the children."

"We need more materials. When two classes are working on the same experiment we don't have enough to go around."

"Please keep Concepts. I would also like at least five more textbooks because the investigations do need background."

"The science room was an asset to the program. The children enjoyed going to a different room and it made science seem more 'important' as a subject."

"If a lab is to be used, it requires running water in the room to be most effective."

The responses to the Teacher Questionnaire were indicative of teacher sentiment and opinion about the science pilot projects. The members of the Science Curriculum Study Group were impressed with the degree of sincerity and candor expressed in the teacher comments. It was decided that since the results of other evaluative instruments were somewhat inconclusive, the teacher responses would be given priority consideration in arriving at decisions and recommendations for future programming.

3. Review of Responses to Parent Questionnaire. One of the most impressive aspects of the results of the Parent Questionnaire was the very high rate of return. The chart below indicates the percentage of parents who returned the questionnaire in each of the elementary schools in Tenafly:

Percent of Parents Returning Parent Questionnaire by School

Mackay School	79%
Maugham School	80%
Smith School	77%
Stillman School	63%

There was an unusually enthusiastic response to the questionnaire. In most instances teachers have to provide several reminders in order to insure return of papers and other materials sent home. In this case, however, teachers found that parents gladly returned and provided thoughtful comments on the questionnaires.

Table III summarizes the "yes-no" responses to questions posed to parents in the questionnaire. (A copy of this instrument appears in Appendix F.) Analysis of the results of the Parent Questionnaire suggests a most positive response on the part of parents. Question 5, which asked whether or not children have conducted any science experiments at home, elicited the least positive response with only 55 percent of the parents indicating that this was the case. The results of parental responses to the other four questions, though, were affirmative in a ratio of about four to one.

It is interesting to note that when the results of Parent Questionnaires were analyzed by grade level, the least favorable responses occurred at the fourth and fifth grade levels at Maugham, Smith, and Stillman Schools. This is coincident with the decreased level of satisfaction expressed by teachers of these grade levels in these same schools, i.e. those using the SCIS-II program.

The members of the Science Curriculum Study Group reviewed all of the written comments offerred by parents and categorized them as positive (supportive) or negative (critical). Table IV is a tally of the number of written comments made by parents and their classification as positive or negative as perceived by the members of the Study Group. It should be noted that the distribution shown in Table IV is only indicative of the categorization of written remarks made by those parents who chose to offer comments. The overwhelmingly positive nature of these remarks (92% positive vs. 8% negative) coupled with the very high rate of return of the Parent Questionnaires was most encouraging. Not only was parental response willingly offerred, but it also indicated a very positive view of the efforts in elementary science in Tenafly schools this year.

An extensive survey of all written comments was conducted, and it was decided to list a sampling of them which represented the broad range of remarks. Care was taken to ensure that the proportion of positive to negative comments listed below followed the same ratio as found in the entire group of returned questionnaires.

(Text continues on p. 43)

TABLE III

Percent Responding "Yes and No" to Questions on the Parent Questionnaire by Question and School.

QUESTIONS

School	1. Aware of new Science Program		2. Child relates School experiences At home		3. Child shows Increased Interest in Science		4. Greater Science Emphasis in School this Year		5. Child does Experiments At home	
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Mackay	88	12	79	21	78	22	92	8	56	44
Maugham	79	21	86	14	82	18	87	13	61	39
Smith	59	41	76	24	67	33	69	31	45	55
Stillman	72	28	70	30	56	44	56	44	56	44
Average	75	25	78	22	71	29	76	24	55	45

TABLE IV - Distribution of Positive and Negative Written Comments Offerred by Parents Responding to the Parent Questionnaire

School	Number of Positive Comments	Percent Of Total	Number of Negative Comments	Percent Of Total
MACKAY	52	98%	1	2%
MAUGHAM	43	98%	1	2%
SMITH	32	84%	6	16%
STILLMAN	29	83%	6	17%
TOTALS	156	92%	14	8%

"We have been impressed by the comments our sons have made during this school year. They seem to enjoy the science lessons and learn from them. Their retention of the information taught has been excellent! Please continue with the program!!"

"My son's interest in nature seems to have increased through this year's program. Their field trip helped, but just his questions and comments show an awareness not previously noted."

"Since science is one of my child's special interests, we are delighted to see an enhanced science program in the school."

"I feel the increased emphasis on science is very important and welcomed!"

"The science program at Mackay is great and I hope it continues."

"(Child's name) talks about the science projects and relates them to what she sees happening in the environment."

"I do not feel the children are being sufficiently stimulated in this area."

"Keep up the good work! The science experiments have encouraged a greater interest in this area for elementary school children."

"My daughter has commented on the results of class experiments and projects and has shown an increased interest in repeating them at home. She is also increasingly inquisitive about the world around her."

"Our daughter has brought home her enthusiasm and results of many science experiments conducted by her second grade class. She has recreated some of them at home and shared her findings with the entire family. We feel this new science program has sparked an interest in her that, hopefully, will be nurtured throughout her education."

"Since science is of great interest to my son, I am delighted that it is being emphasized more in the school curriculum."

"As my son started in your school in January, we did not know about the new science program. I did notice that your science program is better than in his last school."

"A better science program was long overdue. I think the creative programs begun now will be reflected in higher grades later on."

"Science is now a 'favorite subject!' Mr. Donatella has also been a terrific influence."

"There has never been any reading in science for homework or science activity homework. The science experience that was related to me was devoid of any conceptual framework."

"It is exciting to see my son's thinking and his relating school experiences to things happening at home."

"We have had rubbery chicken bones, battery-run motors, very clean pennies, etc. in our house this year. My son has learned a very great deal and has brought it home."

"The interest and enthusiasm that my son has shown in science is a reflection of the program. Please continue with it and keep up the good work!!"

"Seems that many experiments in school are done mechanically."

"Mr. Donatella has really started an interest in science in the children. They really enjoy it!"

"My daughter was obviously stimulated by the science work done in school as she transferred her knowledge to home."

"It's good to see an increased active 'hands-on' approach in science. Keep it up!"

"I think this is a great program for our youngster. I see a lot of interest in him for science.

"(Child's name) has been very excited by his experiments and tries to do his own at home."

"I think it is vital that the 'hands-on' program instituted this year be continued. Our daughter found the science program very exciting."

"My daughter has been excited about science all year. I am delighted with the program."

"I have noticed a definite new enthusiasm and increased interest in my daughter. She delights in doing experiments at home and considers science 'fun'!"

"My children have enjoyed the science program very much this year."

"The new, expanded science curriculum is terrific. I don't always have the answers to my son's questions which makes the parents learn, too!"

Some parents chose to comment upon the efforts to publicize the science pilot programs. A few remarks of this nature follow:

"I only realized that a new science curriculum was in place with the recent excellent issue of 'Science Alert'."

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"The science newsletters were interesting and informative. I hope the program will be expanded even further in the future."

"I like the science bulletins that come home periodically, SCIENCE ALERT."

"The newsletter 'Science Alert' and the provision of a science room exhibits a heightened commitment on the part of our school system."

The final question incorporated into the Parent Questionnaire asked if parents would note any special talents, interests, or abilities in science which might enhance the science programs. Twenty-two parents identified themselves as potential resources. Included among the occupations or interests indicated were:

chemistry teacher
dentist
hospital administrator
photographer
cardiac physiology researcher
owner of a reflecting telescope
insect and reptile collector
ceramic artist
neurobiologist
immunological researcher
transplantation immunologist
nephrologist

4. Results of the Third Grade Science Process Test.

In the first part of the process test, data was generated regarding student ability to release a single drop of liquid from an eyedropper. Five categories were established for assessing the degree of difficulty encountered in releasing a single drop.
It is noted that to score in the "None" category, (0), no difficulty at all would have been experienced in releasing a drop. Moving to the right of the scale, the amount of difficulty increases. For example, if a youngster were to score in the "6-8" category (Considerable Difficulty), the student would have had to unsuccessfully release between six and eight drops out of the approximately thirty drops contained in one full eyedropper. Examination of the data represented in Table V shows a somewhat "normal" distribution or bell curve. If the two middle categories are combined, it is revealed that a total of 80 percent of the students had "Very Little" or "Some" difficulty producing single drops. Only 10 percent of the children experienced no difficulty in completing the task, and at the other extreme, 10 percent of the pupils experienced considerable difficulty in executing the task. (Not represented in the Table, but noted by the

(Text continues on Page 47.)

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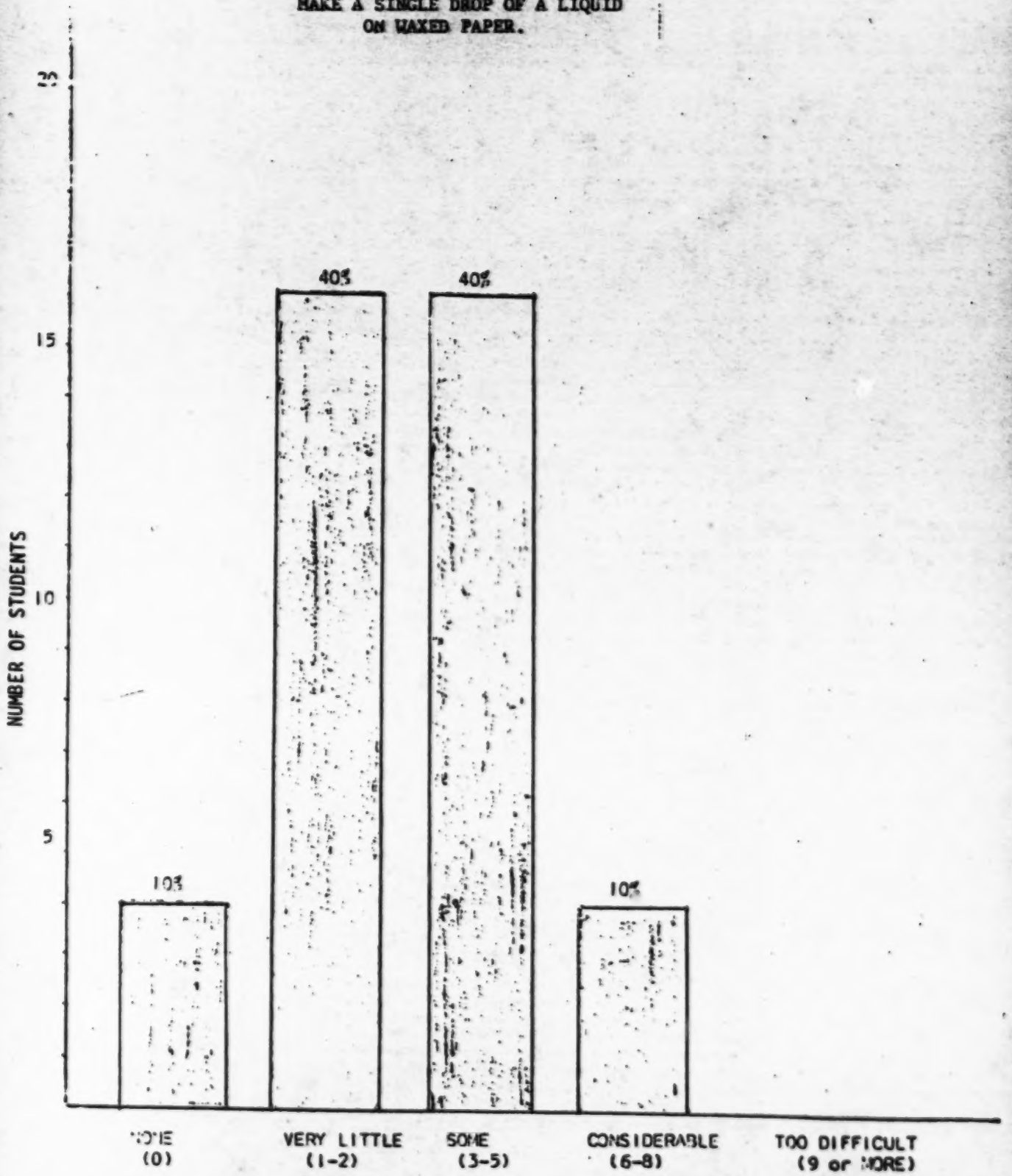
TABLE V

BAR CHART OF STUDENT ABILITY TO MAKE A SINGLE DROP OF A LIQUID ON WAXED PAPER.



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tester, Mr. Donatella, was the observation that when difficulty was experienced by the students, it occurred only at the outset of the task, but did not persist throughout the procedure.)

There appears to be one clear outcome. For children in Tonafly's third grades, district-wide, using an eyedropper is a reasonable task. It does require considerable small motor skill and coordination of eye-hand movements, but the great majority of youngsters tested were able to perform the operation successfully.

The second part of the process test was the observation, over a five-minute period, of how students compared drops of the two different liquids. The tester observed the pupils' actions and the sequence of events which transpired. Typical examples follow:

-The child picked up the magnifier, looked at a red drop and stated, "...it is spherical or puffy."

-He then looked at a blue drop and stated, "...it looks flat and not as high as the red drop."

-He took the eyedropper, and touched a red drop, and a blue drop and said, "the red drop holds together better than the blue drop and the colors seem to mix and form a purple color when the drops come together."

This kind of sequence is typical and a record was kept by Mr. Donatella of each child's actions noting both the events and the comments offered as a child made observations.

A complete record of all observations made by the students has been kept for future reference and comparison. It will be of interest in future evaluations to note any significant change in these indicative observations.

Without stating all of the observations made by each student, there are some general comments that characterize the scope and magnitude covered:

-The fluency with which the comments were made far exceeded the examiner's expectations.

-The level of reasoning and method of intestigating the materials indicated a self-confidence on the part of the students as well as comfort with the tester.

-While the vast majority of students made careful, well-justified observations, there were some observations (perhaps about 10 percent) which indicated sophisticated inferential thinking.

Analysis of the results of this test demonstrates that Tenafly youngsters are well able to make accurate observations and formulate hypotheses and conclusions. It is difficult to quantify the level of observational and inferential skill; however, it is clear that the children have profited from the "hands-on" approach in science to the degree that they felt comfortable, secure, and enthusiastic about manipulating materials and performing directed tasks and experiments.